Disappeared Pulsatile Tinnitus Related to Petrous Segment Stenosis of the ICA after Relief of the Stenosis by Stenting

Y.K. IHN[1], W.S. JUNG[1], B-S. KIM[2]

[1] *Department of Radiology, St.Vincent's Hospital, The Catholic University of Korea; Suwon, Korea*
[2] *Seoul St.Mary's Hospital, The Catholic University of Korea; Seoul, Korea*

Key words: tinnitus, stenosis, stent, ICA

Summary

Pulsatile tinnitus may result from turbulent flow within the internal carotid artery (ICA). Atherosclerotic carotid stenosis is a rare but well-known cause of pulsatile tinnitus. The classical treatment was endarterectomy or ligation for proximal ICA disease or stenting for distal ICA lesions. Endovascular techniques offer new ways to treat atherosclerotic vascular stenosis lesions. We describe two cases of pulsatile tinnitus caused by stenosis within the petrous segment of the ICA and treated by stent-assisted angioplasty.

Introduction

Pulsatile tinnitus is defined as occurring when a patient describes hearing a sound synchronous with the heartbeat.

Although this is an uncommon otological symptom, it may be the presenting and only symptom of conditions such as dural arteriovenous fistula, carotid cavernous fistula, and atherosclerotic carotid stenosis.

Atherosclerotic carotid artery stenosis is a rare but recognized cause of objective pulsatile tinnitus.

The classical treatment of such lesions consisted of carotid endarterectomy, ligation, and balloon embolization of the internal carotid artery following test occlusion.

We present two cases of objective tinnitus caused by atherosclerotic carotid artery disease and treated using stent-assisted angioplasty.

Case Reports

Case 1

A 53-year-old man presented with a left-side pulsatile tinnitus of six months' duration which had become much more severe during the previous three months. The patient had a history of hypertension and hypercholesterolemia. His neurologic, ear, nose, and throat examinations were normal. No neck bruit was identified. Carotid duplex studies showed no evidence of carotid artery stenosis in the bulb region, however, subsequent MR angiography (MRA) showed focal narrowing of the petrous segment of the left ICA (Figure 1A).

Brain SPECT showed substantial flow reduction in the left temporal lobe. As diagnostic subtraction angiography showed 80% stenosis of the cervico-petrous segment of the left ICA (Figure 1B), we decided to perform stent-assisted angioplasty.

The patient was premedicated with daily doses of aspirin 100 mg and clopidogrel 75mg (Plavix; Sanofi-Synthelabo, Seoul, Korea) for five days before the procedure. Percutaneous access was obtained via the right femoral artery, and a 6F sheath was inserted.

The patient received full systemic heparinization just before the therapeutic procedure. A 6F guiding catheter (Envoy; Cordis Endovascular Corporation, Miami, FL, USA) was positioned in the distal cervical ICA.

The stenotic segment of the petrous ICA was crossed with a 0.014- inch guide wire (Transend, Boston Scientific, Fremont, CA, USA). A 3.5-

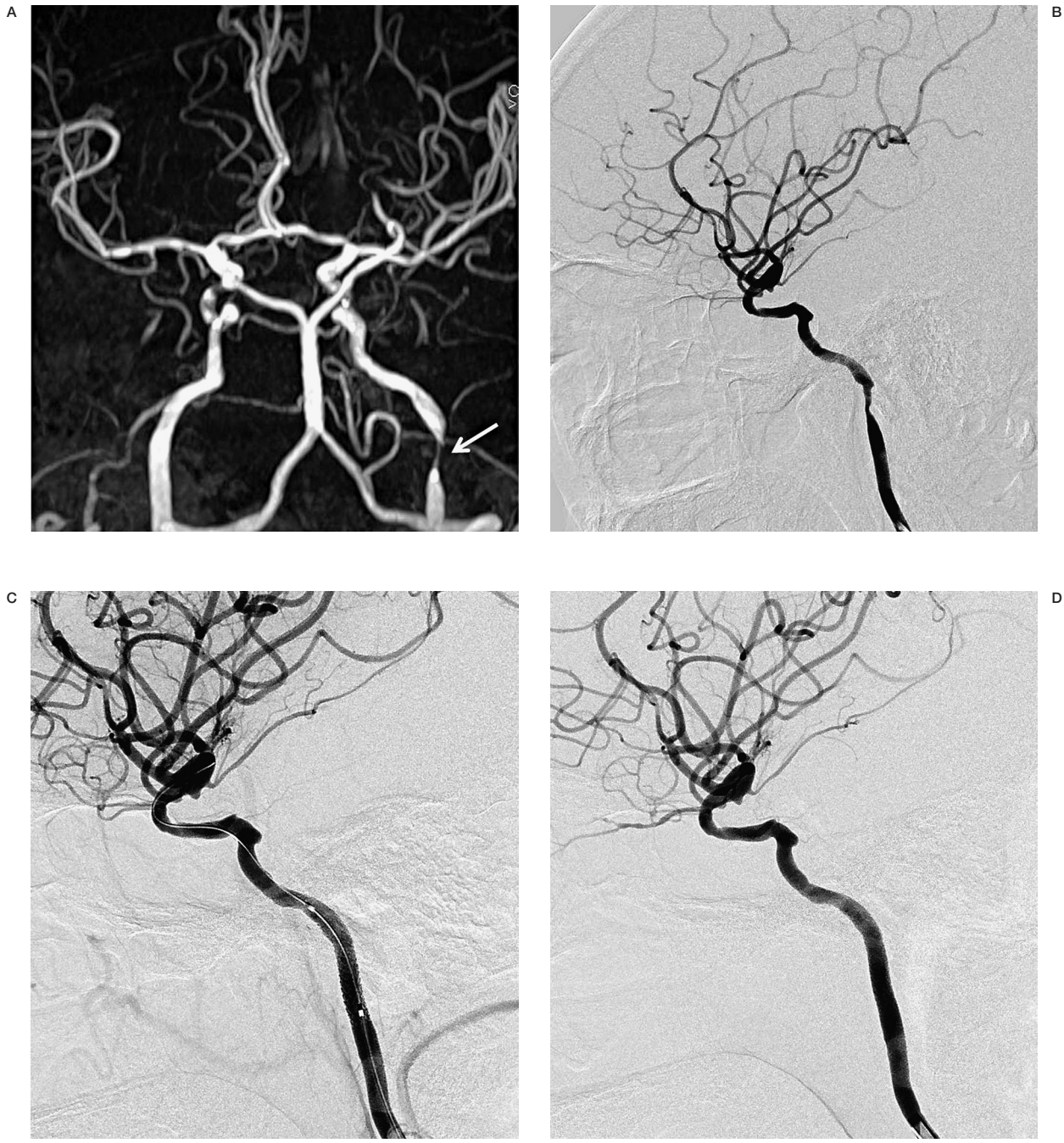

Figure 1 A 53-year-old man with left side pulsatile tinnitus. A) TOF MRA shows focal severe stenosis in the left petrous ICA (arrow). B) Lateral angiogram of the left ICA shows a petrous atherosclerotic stenotic lesion. C) Lateral magnified radioscopic view demonstrates the distally placed guidewire, balloon marks, and implanted stent. D) Postoperative angiogram reveals the nearly – normal diameter of the vessel.

mm × 18-mm stent (Driver, Medtronic, Minneapolis, MN,USA) was then positioned across the stenosis (Figure 1C). The stent was expanded by inflation of the balloon to 7 atm.

The residual stenosis responded to repeated dilatation at 12 atm. The proximal portion of the stent was then further dilated by inflating the balloon to 15 atm. Post-procedural angiography revealed no residual stenosis (Figure 1D). Arteries supplying the left cerebral hemisphere re-

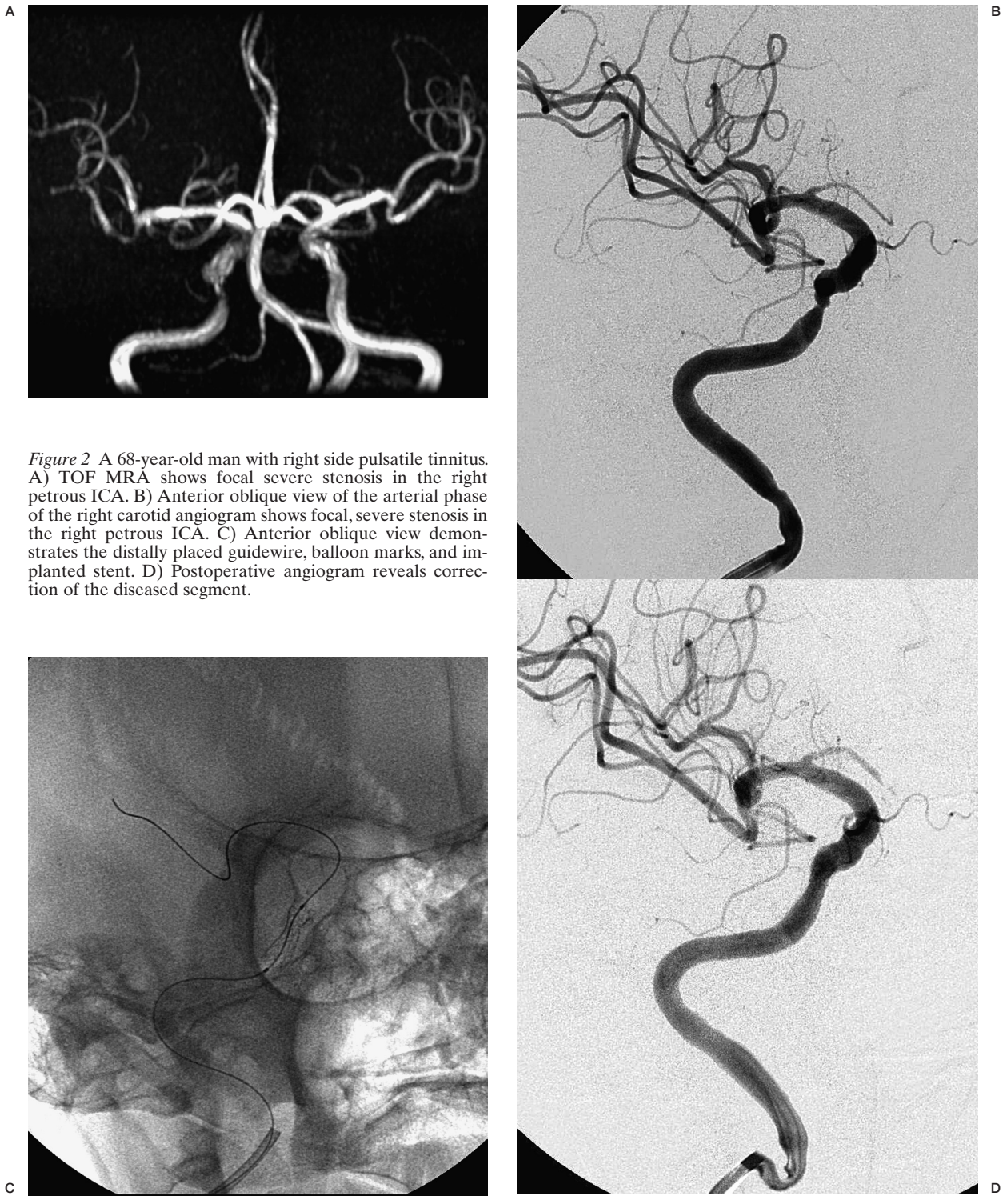

Figure 2 A 68-year-old man with right side pulsatile tinnitus. A) TOF MRA shows focal severe stenosis in the right petrous ICA. B) Anterior oblique view of the arterial phase of the right carotid angiogram shows focal, severe stenosis in the right petrous ICA. C) Anterior oblique view demonstrates the distally placed guidewire, balloon marks, and implanted stent. D) Postoperative angiogram reveals correction of the diseased segment.

mained normal. The patient experienced no adverse neurologic sequelae and was discharged from the hospital three days later. He has had complete relief of his tinnitus and is currently doing well.

Case 2

A 68-year-old man presented with tinnitus in the right ear of approximately two months' duration. While initially intermittent, the sound

became constant and increased in intensity. The tinnitus eventually makes his life stressful. Carotid duplex studies showed no evidence of carotid artery stenosis in the bulb region. TOF MRA revealed stenosis of the petrous segment of the right ICA (Figure 2A). The patient was treated with a two-month trial of dual antiplatelets (aspirin and clopidogrel). After two months of conservative therapy, follow-up MRA demonstrated no remarkable change in the stenosis first noted in the same region. The patient had no history of amaurosis fugax or of transient ischemic events, although he did have a ten-year history of arterial hypertension and insulin-dependent diabetes mellitus. Physical examination revealed a bruit heard on the right side of his neck, although the results of the neurologic examination were otherwise normal. Digital subtraction angiography revealed stenosis of the distal petrous segment of the right ICA (70% diameter stenosis) (Figure 2B). The patient refused further conservative treatment due to his fear of the risk of a possible stroke and unbearable tinnitus associated with carotid artery stenosis. We therefore decided to perform stent-assisted angioplasty. A right femoral approach was used to place a 6F Shuttle® guiding sheath (Cook, Bloomington, IN, USA) into the distal right common carotid artery. A 6F guiding catheter was placed at the right proximal cervical internal carotid artery. A 0.014-inch guide wire (Transend, Boston Scientific, Fremont, CA, USA) was then placed across the stenosis with balloon expandable stent. A 5-mm × 18-mm stent (Genesis, Cordis, Warren, NJ, USA) was then positioned across the stenosis (Figure 2C). The stent was expanded by inflating the balloon to 9 atm. Post-therapeutic angiography showed no significant residual stenosis (Figure 2D). The arteries supplying the right cerebral hemisphere remained normal. The patient tolerated the procedure well. He reported that the noise in his right ear had disappeared after completion of the procedure. The bruit had, therefore, been clinically resolved, and the patient has remained neurologically normal.

Discussion

Tinnitus is defined as pulsatile when a patient describes a sound synchronous with the heartbeat. Pulsatile tinnitus, an uncommon otological symptom, has been attributed to many different neoplasms and vascular pathologic processes including dural arteriovenous fistula, carotid cavernous fistula, stenotic lesion of the ICA, cerebral aneurysm, and arterial dissection [1-3].

Pulsatile tinnitus is a rare symptom, although the correct diagnosis is critical, as in the majority of cases the underlying etiology is treatable. Most neoplasms and vascular anomalies are best seen on bone algorithm computed tomographic (CT) studies. As dural vascular malformations are often elusive on all types of cross-sectional imaging studies; conventional angiography may be necessary in order to make a diagnosis. Flow-sensitive magnetic resonance (MR) images can show the vascular loops compressing the eighth cranial nerve. Carotid dissections, aneurysms, atherosclerosis, and fibromuscular dysplasia can be identified on either MR imaging or MR angiographic studies as well as on either CT or CT angiographic studies [4].

Pulsatile tinnitus is often associated with atherosclerotic carotid artery stenosis of the ICA, a phenomenon described in the neurology and vascular surgery literature. Sismanis et al. [5] reported that carotid artery atherosclerosis should be highly suspected in patients more than 50 years old and who have risk factors for atherosclerosis. In another study by Sismanis, mild to severe carotid artery stenosis due to ACAD was the cause of pulsatile tinnitus in 16% of their 145 study patients [6]. According to several studies, the frequency of tinnitus increases in older individuals. Furthermore, as the older population and the risk factors for atherosclerosis, i.e., smoking, stressful life style, and lack of exercise increase, more people with pulsatile tinnitus caused by carotid artery atherosclerosis will be identified.

Tinnitus is believed to be a consequence of the transmission of sound, and is created by turbulent flow through the petrous bone to the cochlea. Dilation of the stenotic arterial segment using a stent eliminated stenosis-associated turbulent flow, resulted in resolution of the tinnitus in our study patients.

Tinnitus attributable to stenosis at the common carotid artery bifurcation has been successfully treated by ligation or carotid endarterectomy (CEA) [7]. However, curing this entity by endovascular stent angioplasty has received little attention in the literature [8,9].

The recent advent of a new generation of stents has encouraged clinicians to consider performing stent-assisted angioplasty as an alternative approach to angioplasty alone for intracranial stenosis.

However, the SAMMPRIS trial showed that the stenting group had a significantly higher 30-day rate of stroke or death than the aggressive medical group (14.7% vs 5.8%) as well as one-year rate of stroke or death (20.0% vs 12.2%) [10].

In our patients, stenoses were located in the petrous ICA and pulsatile tinnitus occurred as the first symptom. The location of the stenosis made the lesion inaccessible to direct surgical ligation of the ICA or CEA. Furthermore, the fact that the tinnitus disappeared after the procedure confirmed the relationship between the stenosis and the disturbing murmur. We performed stent-assisted angioplasty using a balloon-expandable stent. According to Suh et al. [11], balloon-expandable intracranial stent placement can be safely performed in stable symptomatic patients and adverse effect rate was much lower in the stable patient group (4.1%) compared with that in the unstable patient group (25.9%). Terada et al. also reported that stent placement is more effective than percutaneous angioplasty for stenosis of the petrous or cavernous portion of the ICA and has low periprocedural morbidity (4.2%). Considering the lesion characteristics, as long as stenotic lesions are short (< 15 mm in length) and large (> 3 mm in diameter) as they were in our cases, the petrous ICA might be a good candidate for stent placement [12].

As pulsatile tinnitus may be the sole manifestation of severe ACAD, Doppler ultrasonography or MRA is recommended for those patients with risk factors as well as for the elderly (> 50 years). Color Doppler ultrasonography is a noninvasive, cost-effective method to assess suspected extracranial carotid artery atherosclerosis, and MRA has proven to be sensitive and specific for diagnosing internal carotid stenosis [13]. Digital subtraction angiography is usually reserved for patients in whom endovascular or surgical treatment is anticipated.

In conclusion, we believe that atherosclerotic carotid artery stenosis should be considered a possible cause of pulsatile tinnitus, particularly in patients with cardiovascular risk factors. Endovascular treatment of arterial stenosis is effective for improving pulsatile tinnitus in patients with severe carotid stenosis.

References

1 Carlin RE, McGraw DJ, Anderson CB. Objective tinnitus resulting from internal carotid artery stenosis. J Vasc Surg. 1997; 25: 581-583.
2 Lerut B, De Vuyst C, Ghekiere J, et al. Post-traumatic pulsatile tinnitus: the hallmark of a direct carotidocavernous fistula. J Laryngol Otol. 2007; 121:1103-1107.
3 Pelkonen O, Tikkakoski T, Luotonen J, et al. Pulsatile tinnitus as a symptom of cervico cephalic arterial dissection. J Laryngol Otol. 2004; 118: 193-198.
4 Weissman JL, Hirsh BE. Imaging of tinnitus: a review. Radiology. 2000; 216: 342 -349.
5 Sismanis A, Stamm MA, Sobel M. Objective tinnitus in patients with atherosclerotic carotid artery disease. Am J Otol. 1994; 15: 404-407.
6 Sismanis A. Pulsatile tinnitus: A 15-year experience. Am J Otol. 1998; 19: 472-477.
7 Kirkby-Bott J, Gibbs HH. Carotid endarterectomy relieves pulsatile tinnitus associated with severe ipsilateral carotid stenosis. Eur J Vasc Endovasc Surg. 2004; 27: 651-653.
8 Emery DJ, Ferguson RD, Williams JS. Pulsatile tinnitus cured by angioplasty and stenting of petrous carotid artery stenosis. Arch Otolaryngol Head Neck Surg. 1998; 124: 460-461.
9 Hartung O, Alimi YS, Juhan C. Tinnitus resulting from tandem lesions of the internal carotid artery: combined extracranial endarterectomy and intrapetrous primary stenting. J Vasc Surg 2004; 54: 342-348.
10 Chimowitz MI, Lynn MJ, Derdeyn CP, et al; SAMMPRIS Trial Investigators. Stenting versus aggressive medical theraphy for intracranial stenosis. N Eng J Med. 2011; 365: 993-1003.
11 Suh DC, Kim JK, Choi JW, et al. Intracranial stenting of severe symptomatic intracranial stenosis: results of 100 consecutive patients. Am J Neuroradiol. 2008; 29: 781-785.
12 Terada T, Tsuura M, Matsumoto H, et al. Endovascular therapy for stenosis of the petrous or cavernous portion of the internal carotid artery: percutaneous transluminal angioplasty compared with stent placement. J Neurosurg. 2003; 98: 491-497.
13 Westwood ME, Kelly S, Berry E, et al. Use of magnetic resonance angiography to select candidates with recently symptomatic carotid stenosis for surgery: systemic review. BMJ. 2002; 324: 198-202.

Dr Bum-soo Kim, MD
Radiology Department
Seoul St. Mary's Hospital
The Catholic University of Korea
#505 Banpo-dong Seocho-gu
Seoul, 137-701, Republic of Korea
E-mail: bumrad@catholic.ac.kr